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## ENVIRONMENTAL CHEMISTRY, POLLUTION & WASTE MANAGEMENT | RESEARCH ARTICLE

# Determinants of hospital solid waste composition of Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Ile-Ife, Nigeria

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**Abstract:** Hospital solid waste dumped indiscriminately into the municipal bins often increases the chances of survival and mutation of pathogenic microbial population in the waste. Therefore, this study examined the determinants of hospital solid waste composition in Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife. Data were obtained from both primary (Actual measurement of waste in kg) and secondary sources. Waste produced in the wards and clinics were measured for seven days in each week over the period of three months. The study showed that sharps and general waste produced in wards represented 27.3 and 72.7%, respectively. The study also showed that the highest quantity of wastes was generated on Monday representing 15.17%, while the least quantity was on Sunday (11.54%). The daily and weekly per capita waste quantities generated in the wards of OAUTHC were 0.799 and 5.689 kg, respectively. The study concluded that the methods and materials of waste storage in OAUTHC were not in conformity with World Health Organisation standards.

### ABOUT THE AUTHORS

Abel Omoniye Afon is a professor of Urban and Regional Planning, Obafemi Awolowo University with specialty in Waste Management. His research interest includes but not limited to Waste Management, Environmental Psychology, and Climate Change.

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### PUBLIC INTEREST STATEMENT

This study examined the determinants of hospital solid waste composition in Obafemi Awolowo University Teaching Hospitals Complex, (OAUTHC) Ile-Ife. Data were collected through direct measurement of solid waste generated in all the wards except virology department of the hospital. Solid waste generators comprise of mixed gender, age and ethnic groups that visited the hospital during the survey period. The study discovered that solid waste is sorted in two compartments (General and Sharps). General waste identified include: disposables, anatomical waste, used cotton wool, domestic waste, pathological waste and contaminated pharmaceutical products, while Sharps include: needles, knives, pipettes, scalpels, Infusion sets and saws. Challenges identified were failure to quantify the solid waste generated in reliable records, and intermingling of hazardous waste with domestic waste. Therefore, modalities on periodic waste measurements, and source sorting of waste according to the recommendation of World Health Organization (WHO) should be worked upon.

**Subjects: Environmental Studies & Management; Social Sciences; Urban Studies; Behavioral Sciences**

**Keywords: solid waste; hospital solid waste; waste composition; disposal practices**

## 1. Introduction

Waste is an inevitable by-product of man's developmental activity. It is regarded as useless, unwanted or discarded substance or material either temporarily or permanently valueless to the owner (Ngwuluka, Ocheke, Odumosu, & John, 2009). It could be in gaseous, liquid and solid form (Taylor & Allen, 2006). Solid waste can be referred to as materials generated from human daily activities that no longer have any value to the owner and ready to be discarded into the environment. Solid waste generation deals with the release of substance into the environment as a result of several activities which the materials are valueless to the owner at that time. The sources of solid waste are dependent on the socioeconomic and technological levels of a society (Tadesse, 2004). Sources of solid waste include but are not limited to household or domestic, commercial, industrial, process or manufacturing, construction, and demolition. Others may also include agricultural, mining, radioactive, institutional, and most importantly, health care.

It is ironic that health care setting, which is established to restore and maintain the community health, is also threatening their well-being (Nema, Pathak, Bajaj, Singh, & Kumar, 2011). Waste produced in the course of health care activities entails a higher risk of infection and injuries than municipal waste (Tesfahun, Kumie, Legesse, Kloos, & Beyene, 2014). This is because it consists of general waste, sharps, pathological, infectious, pharmaceuticals, medical devices, and radioactive materials. Hospital waste generation depends on numerous factors such as the social and economic conditions of patients, type of health care facilities (HCF), hospital specialization, available waste segregation options, seasonal variation, the number of bed space and proportion of patients treated on a daily basis (Pruss, Giroult, & RushBrook, 1999).

Health care waste generated from different units in the hospital may cause serious health hazards through transmission of diseases and injury if not properly managed (Kumar, Mazta, & Gupta, 2015). It also contributes to environmental degradation (Mahananda, 2015). Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife Nigeria also contributes significantly to health care waste generation. Health care solid waste can create irrecoverable hazards to hospital personnel, society and the environment if these are not managed correctly. The objective of this paper is to examine the quantity and composition of solid waste generated in Obafemi Awolowo University Teaching Hospitals Complex (OAUTHC), Ile-Ife in order to assist in planning for the appropriate medical waste management system.

## 2. Previous efforts at estimating the quantity of waste generation and their shortcomings

Studies carried out in the past to estimate the quantity of hospital solid waste generation in Nigeria were unreliable as a result of methodological flaws. The available information on the quantity and composition of the waste generated in tertiary hospitals were not reliable. Therefore, to determine the accurate quantity of man and material resources needed to manage solid waste in hospital will be difficult. For example, the work of Ajimotokan and Aremu (2009) and Fadipe, Oladepo, Jeje, and Ogedengbe (2011) attempted the quantification and characterization of health care solid waste through questionnaire administration. Respondents' opinion gave rise to hypothetical quantity. In this study, actual measurement of solid waste generated was carried out.

In some studies, the methods of estimation are questionable. For example, some researchers concentrate on in-patient to determine the per capita waste generation within hospital neglecting the out-patient (Ajimotokan & Aremu, 2009; Cheng et al., 2009; Gavranic, Simic, & Gavranic, 2012; Kheradpisheh and Salehii, 2013; Komilis, Fouki, & Papadopoulos, 2012). This study therefore, examined per capita waste generation rates for both in-patient and out-patient in the study area.

### 3. The study area

The Obafemi Awolowo University Teaching Hospital Complex (OAUTHC), Ile-Ife, Osun State, Nigeria is one of first generation Teaching Hospitals established by the Federal Government to provide qualitative health care delivery to its people. The institution began on the 8th of May, 1972, when the Faculty of Health Sciences was created in the University of Ife (now Obafemi Awolowo University Ile-Ife). This was based on the resolution of the defunct Western State Government of Nigeria to establish medical school in its state-owned university at Ile-Ife. This was done to tackle health problems of the people in the state. On the 1st of July, 1975, the defunct Western State Government of Nigeria established the state health council (Health management system) in Ile-Ife. The Federal Government took-over of all the then existing State owned Universities and their affiliated teaching hospitals on the 1st of November, 1975.

The OAUTHC falls within the latitude  $07^{\circ} 30' 0.0''$  to  $07^{\circ} 31' 6.71''$  and within the longitude  $4^{\circ} 33' 0.0''$  to  $3^{\circ} 34' 30.64''$ . The initial corporate name of the institution was Ife University Teaching Hospital Complex. It was changed to Obafemi Awolowo University Teaching Hospital Complex in 1987. This was done to honor the late Chief Obafemi Awolowo, who died in 1987.

### 4. Methodology

The study utilized both primary and secondary data. Primary data were obtained from actual measurement of waste generated in the hospital wards and clinics. The waste measurement exercise lasted for three calendar months of June, July and August of 2015. Each month's measurement was taken for seven days of the week. This methodology is adopted from (Afon, 2005, 2007, 2009). The time and period of the three consecutive calendar months were selected randomly and hence might not represent the contribution over a full calendar year.

World Health Organization (2005) recommends that waste generated in hospitals should be sorted into the following major components: General waste, Pathological waste, Infectious waste, Sharps, Pharmaceutical waste, and radioactive waste. However, findings on site investigation revealed that all the wards and clinics except for virology department have their waste sorted into two different components, namely general waste and sharps.

Upon this background, every cleaner in all other wards and clinics was given 2(two) polythene bags per period of waste measurement for storage. Each polythene bag was measured using spring balance calibrated at an interval of 0.1 kg and can measure up to 5 kg. Waste generated in every wards, clinics, and laboratory were measured and records were kept accordingly.

Secondary data was obtained from wards, contractors and Head, Department of Environmental Health. Data obtained include number of beds in the wards (where applicable), number of cleaners and contractors responsible for waste management. Data collected were analyzed using descriptive statistics such as cross tabulation and graphs.

### 5. Findings and result

Data used were the measurement of solid waste generated taken in the wards. The measurement lasted for a week in each of three calendar months of June, July, and August of 2015. Identified during the data collection stage were two solid waste components which are General waste and sharps (see Plates 1 and 2). The general waste identified include disposables, anatomical waste, discarded medicines, used cotton wool, domestic waste, pathological waste, expired drugs, spilt and contaminated pharmaceutical products, and vaccines. Sharps include needles, knives, pipettes, scalpels, and other blades such as; Infusion sets, saws, broken glass, and nails.

Daily and weekly total quantities of waste generated were established. Since the total number of persons that generated the quantity of waste in different wards was known, per capita waste quantities were established on daily and weekly bases (see Table 1). Unless otherwise stated, the tables

Plate 1. Waste bin.



Plate 2. Sharp box.



**Table 1. Summary of waste generated and waste per capita in OAUTHC in June, July and August, 2015**

Sections, departments and wards	Months									Total	
	June			July			August			WG	GRT
	WG	GRT	PCW	WG	GRT	PCW	WG	GRT	PCW		
All wards	1,171.8	1,601	0.73192	1,017.8	1,539	0.66134	1,387.4	1,331	1.04237	3,577	4,471

Notes: WG = Waste generated GRT = Generators PCW = Per capita waste.

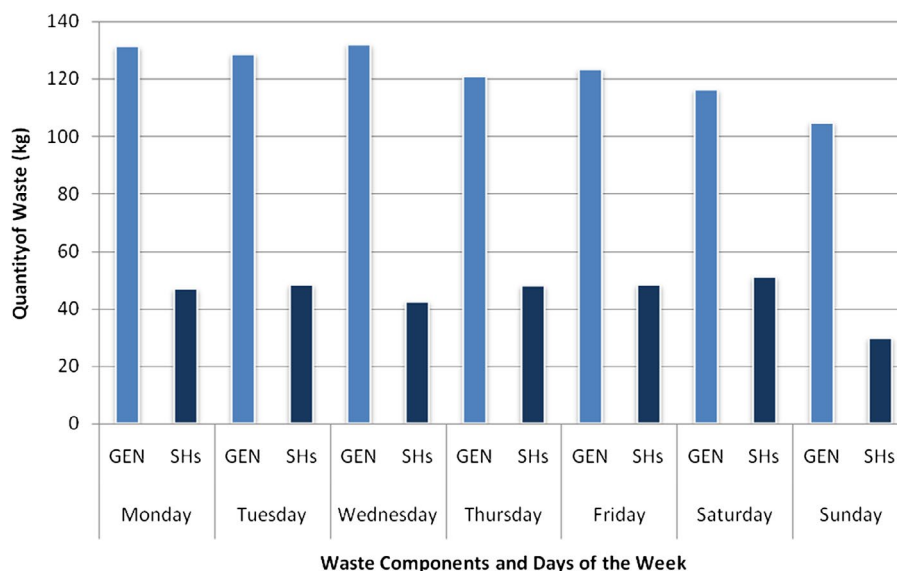
and figures in this chapter were the product of the field survey carried out in 2015. The quantities of the waste are in Kilogram (kg).

### 6. Quantity and composition of waste generated in OAUTHC in June

Findings shown in Figure 1 were the quantity and compositions of waste generated in the wards in the month of June. From Table 2, the total quantity of waste generated for the seven day period was 1,171.8 kg (1.1718 tons). Of this figure, general waste was 856.8 kg in quantity. It represented 73.1% of the total quantity. Sharps weighed 315 kg and represented 26.9%. The analyses along the days of the week showed that the highest quantity of general waste without sharps was generated on Wednesday. The day's proportion represented 11.3% of the weekly generation in June. The highest waste (combination of general waste and sharps) was generated on Monday. It represented 177.9 kg. It is evident that people who need medical attention over the weekend (Saturday and

**Figure 1. Quantity and Composition of Waste Generated in OAUTHC in June.**

Notes: GEN = General waste and SHs = Sharps



Sunday) usually visit the hospital on Mondays for treatment. Sunday experienced lowest proportion of solid waste generated. The Sunday’s proportion represented 124.7 kg. This reflects the low turn-out of the people that need medical attention over the weekend. The hospital does not normally attend to the public on weekends expect for emergency cases.

Table 2 presents the quantity and composition of waste generated in OAUTHC, from Monday to Sunday in the month of June, 2015. From the table, the total general waste generated was 856.8 kg, representing 73.1% of the total quantity generated; Sharps was 315 kg, representing 26.9%. The highest weekly generation was recorded in the Adult emergency ward where 12.7% of the waste was generated. The Postnatal ward generated 10.9%, Antenatal ward generated 9.3%. The least quantity of waste was generated in Antenatal clinic where 1.3% of the total quantity was generated.

The examination of the waste composition showed that the highest quantity of general waste was generated in the Adult Emergency ward (14.8%). The least quantity of general waste was recorded in Antenatal Clinic (1.1%). On the other hand, the highest quantity of sharps was recorded in the Adult Orthopedic ward (7.8%). Antenatal Clinic was where the least quantity of sharps (2.2%) was generated. This is an indication that the Adult Emergency Ward produced the highest quantity of waste among the wards in OAUTHC.

The high quantity of waste generated in Adult Emergency could be associated to the fact that the ward received the highest number of patients on referrer from other hospitals as well as accident victims during both day and night. Antenatal Clinic generated the least quantity of waste because Antenatal patients only come for consultation on clinic days which are open for just 8 h from Monday to Friday. This could have a significant effect on the generation rate. Hence, frequency of patronage and services rendered in different wards of the hospital is a determinant for volume of solid waste recorded across the wards.

**Table 2. Quantity and composition of waste generated in OAUTHC for the month of June**

Ward	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Grand total		
	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	Total
A	12.1	3.8	3.7	3.9	8	1.7	4.7	1.9	5.9	2.2	2.8	2.3	3	1.3	40.2	17.1	57.3
B	4.4	3.6	4.1	3.7	3	1.8	3.3	2	3.7	2.2	2.4	2.2	2.1	1.2	23	16.7	39.7
C	3.7	2.4	4.6	2.6	2.4	1.5	2.4	1.6	2.5	1.8	2.4	1.8	2	1	20	12.7	32.7
D	27.2	3.6	27	4.2	15.7	2.5	13.1	3	13.1	3.3	15	3.6	16	2	127.1	22.2	149.3
E	3.6	3.2	7.6	3.3	5.9	3.5	5.7	3.6	6.4	4.2	5.4	4.4	8.1	2.4	42.7	24.6	67.3
F	1.4	1.8	1.3	2	1.3	2.1	1.7	2.2	2.2	2.5	1.1	2.6	1.4	1.3	10.4	14.5	24.9
G	4.2	2.9	3.9	3	5.1	3.1	5.6	3.3	4.5	1.6	4.1	1.7	3.7	1	31.1	16.6	47.7
H	3	1.7	2.6	1.8	3.5	1.9	3.2	2.2	2.8	1.6	3.7	1.6	2.1	0.9	20.9	11.7	32.6
I	8.8	1.6	7.6	1.8	16.3	2	9.2	2.2	9.4	2.3	8.3	2.4	15	1.3	74.6	13.6	88.2
J	3.6	3.7	3.6	4	2.9	4.2	2.4	4.6	5.4	2.9	2.5	1.1	3.9	0.9	24.3	21.4	45.7
K	13.2	2.9	11.6	3	10.6	3.1	14.3	3.4	11.3	3.5	14.9	4.1	10.7	2.3	86.6	22.3	108.9
L	2.2	1.4	1.2	1.6	2.6	1.7	1.7	1.8	2.9	2	3.1	2.2	2.1	1.2	15.8	11.9	27.7
M	13.4	1.2	20.1	1.2	18.3	1.5	19.4	2	12.8	2.5	16.8	3.1	13.1	1.9	113.9	13.4	127.3
N	1.7	3.8	1.6	2.2	2.1	0.7	1.8	0.9	1.7	1.2	2.1	1.6	1.2	0.9	12.2	11.3	23.5
O	4	1	3.8	1.1	4.6	1.2	2.9	1.4	4.5	1.8	3.1	2.3	2.1	1.2	25	10	35
P	4.1	1.4	3.9	1.5	3	1.6	3.1	1.6	3.7	1.7	3.1	1.9	1.9	1.2	22.8	10.9	33.7
Q	1.5	1.6	2.8	1.6	1.5	1.7	2.3	1.8	3.4	2	4.4	2.1	2.1	1.8	18	12.6	30.6
R	2	0.4	1.2	0.4	3	0.6	2.9	1.6	2.1	1.7	2	1.8	1.8	1	15	7.5	22.5
S	1.2	0.6	1.2	0.8	1.3	0.9	1.7	1	1.6	1	1.1	1.2	1.2	0.9	9.3	6.4	15.7
T	7	2.2	4.9	2.2	6.8	2.5	5.8	2.7	6.7	2.8	5.4	3	2.1	1.6	38.7	17	55.7
U	1.6	0.6	2.1	0.9	4.4	1	5.9	1.2	4.6	1.4	5.6	1.8	3.9	1.2	28.1	8.1	36.2
V	7.2	1.4	8.2	1.5	9.6	1.7	7.8	1.9	12.1	2.2	6.9	2.4	5.3	1.4	57.1	12.5	69.6
Total	131.1	46.8	128.6	48.3	131.9	42.5	120.9	47.9	123.3	48.4	116.2	51.2	104.8	29.9	856.8	315	1,171.8
Total waste generated (kg)	177.9		176.9		174.4		168.8		171.7		167.4		134.7		1,171.8		
Percentage	15.2		15.1		14.9		14.4		14.6		13.3		11.5		100		
Number of Generators	232		227		237		227		230		220		228		1,601		
Per capita (kg)	0.767		0.779		0.736		0.744		0.747		0.761		0.591		0.732		

Notes: A = Children Ward; B = Pediatric Surgery; C = Children Emergency; D = Adult Emergency; E = Adult Orthopedic; F = Gynecological Ward; G = Male Surgical; H = Female Surgical; I = male Medical; J = Female Medical; K = Antenatal Ward; L = Postnatal Clinic; M = Postnatal Ward; N = Surgical Outpatient; O = Ear, Nose & Throat; P = Mental Health; Q = Children Orth. Ward; R = Dermatology; S = Antenatal Clinic; T = Radiology; U = Renal Ward; V = Burns.

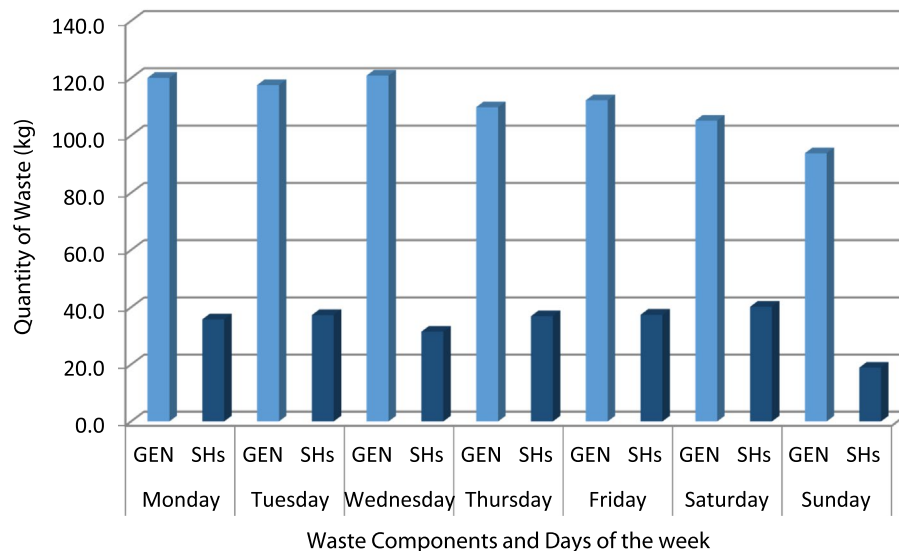
### 7. Quantity and composition of waste generated in OAUTHC in July 2015

A summary of the quantities of waste generated in July, 2015 is presented in Figure 2. From Table 3, waste generated for the week was 1,017.8 kg (1.017 ton) General waste accounted for 779.8 kg representing 76.6%, while sharps accounted for 238 kg representing 23.4%. There was a reduction in the quantity of waste generated in July when compared with that of June. The difference was 154 kg (14% reduction). However, the trend in June was also observed in July. This was because the



**Figure 2. Quantity and composition of waste generated in OAUTHC in July.**

Notes: GEN = General waste and SHs = Sharps.



highest quantity of general waste was also generated on Wednesdays. The Wednesday's generation represented 11.9%. The highest quantity of sharps generation was recorded on Saturday which represented 3.9%. The lowest waste generation was recorded on Sundays where 11.1% (9.2% General waste and 1.9% Sharps) of the weekly generation was experienced.

Presented in Table 3 is the quantity and composition of waste generated from the different wards in the study area in July. It was established that general waste generated for the month of July was 779.8 kg, representing 76.6% of the total waste generated. While sharps accounted for 238 kg (23.4%). From the total of 1,017 kg, the Adult Emergency ward generated 142.3 kg comprising 123.6 kg of general waste and 18.7 kg of Sharps. Postnatal ward generated 11.8% and waste from Antenatal ward produced 10.0% of the total waste generated for the month of July. The least waste generation was recorded in antenatal clinic, where 0.9% of the total quantity of waste generated in July was produced.

The highest producer of general waste was Adult Emergency Ward. This was where 15.9% of the monthly generation was produced. The Antenatal ward received the least generation of general waste (0.7%). The Adult Orthopedic and Antenatal Wards were prolific producers of Sharps. The proportions of the sharps were 7.89% and 7.85%, respectively in the wards.

The highest quantity of waste generated at the Adult Emergency Ward could be associated with the fact that, the ward received large number of patients both within and outside the region. However, the least quantity of waste was generated at Antenatal Clinic. This is because patients usually come for consultation only. Any emergency case in Antenatal Clinic is usually referred to necessary wards.

**Table 3. Quantity and composition of waste generated in OAUTHC in July**

Ward	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Grand total		
	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	Total
A	11.6	3.3	3.2	3.4	7.5	1.2	4.2	1.4	5.4	1.7	2.3	1.8	2.5	0.8	36.7	13.6	50.3
B	3.9	3.1	3.6	3.2	2.5	1.3	2.8	1.5	3.2	1.7	1.9	1.7	1.6	0.7	19.5	13.2	32.7
C	3.2	1.9	4.1	2.1	1.9	1.0	1.9	1.1	2.0	1.3	1.9	1.3	1.5	0.5	16.5	9.2	25.7
D	26.7	3.1	26.5	3.7	15.2	2.0	12.6	2.5	12.6	2.8	14.5	3.1	15.5	1.5	123.6	18.7	142.3
E	3.1	2.7	7.1	2.8	5.4	3.0	5.2	3.1	5.9	3.7	4.9	3.9	7.6	1.9	39.2	21.1	60.3
F	0.9	1.3	0.8	1.5	0.8	1.6	1.2	1.7	1.7	2.0	0.6	2.1	0.9	0.8	6.9	11.0	17.9
G	3.7	2.4	3.4	2.5	4.6	2.6	5.1	2.8	4.0	1.1	3.6	1.2	3.2	0.5	27.6	13.1	40.7
H	2.5	1.2	2.1	1.3	3.0	1.4	2.7	1.7	2.3	1.1	3.2	1.1	1.6	0.4	17.4	8.2	25.6
I	8.3	1.1	7.1	1.3	15.8	1.5	8.7	1.7	8.9	1.8	7.8	1.9	14.5	0.8	71.1	10.1	81.2
J	3.1	3.2	3.1	3.5	2.4	3.7	1.9	4.1	4.9	2.4	2.0	0.6	3.4	0.4	20.8	17.9	38.7
K	12.7	2.4	11.1	2.5	10.1	2.6	13.8	2.9	10.8	3.0	14.4	3.6	10.2	1.8	83.1	18.8	101.9
L	1.7	0.9	0.7	1.1	2.1	1.2	1.2	1.3	2.4	1.5	2.6	1.7	1.6	0.7	12.3	8.4	20.7
M	12.9	0.7	19.6	0.7	17.8	1.0	18.9	1.5	12.3	2.0	16.3	2.6	12.6	1.4	110.4	9.9	120.3
N	1.2	3.3	1.1	1.7	1.6	0.2	1.3	0.4	1.2	0.7	1.6	1.1	0.7	0.4	8.7	7.8	16.5
O	3.5	0.5	3.3	0.6	4.1	0.7	2.4	0.9	4.0	1.3	2.6	1.8	1.6	0.7	21.5	6.5	28.0
P	3.6	0.9	3.4	1.0	2.5	1.1	2.6	1.1	3.2	1.2	2.6	1.4	1.4	0.7	19.3	7.4	26.7
Q	1.0	1.1	2.3	1.1	1.0	1.2	1.8	1.3	2.9	1.5	3.9	1.6	1.6	1.3	14.5	9.1	23.6
R	1.5	-0.1	0.7	-0.1	2.5	0.1	2.4	1.1	1.6	1.2	1.5	1.3	1.3	0.5	11.5	4.0	15.5
S	0.7	0.1	0.7	0.3	0.8	0.4	1.2	0.5	1.1	0.5	0.6	0.7	0.7	0.4	5.8	2.9	8.7
T	6.5	1.7	4.4	1.7	6.3	2.0	5.3	2.2	6.2	2.3	4.9	2.5	1.6	1.1	35.2	13.5	48.7
U	1.1	0.1	1.6	0.4	3.9	0.5	5.4	0.7	4.1	0.9	5.1	1.3	3.4	0.7	24.6	4.6	29.2
V	6.7	0.9	7.7	1.0	9.1	1.2	7.3	1.4	11.6	1.7	6.4	1.9	4.8	0.9	53.6	9.0	62.6
Total	120.1	35.8	117.6	37.3	120.9	31.5	109.9	36.9	112.3	37.4	105.2	40.2	93.8	18.9	779.8	238	1,017.8
Total waste generated (kg)	155.9		154.9		152.4		146.8		149.7		145.4		112.7		1,017.8		
Percentage	15.3		15.3		15.0		14.4		14.7		14.2		11.1		100		
Number of generators	228		229		227		223		208		208		216		1,539		
Per capita (kg)	0.684		0.676		0.671		0.658		0.720		0.699		0.522		0.661		

Notes: A = Children ward; B = Pediatric surgery; C = Children emergency; D = Adult emergency; E = Adult orthopedic; F = Gynecological ward; G = Male surgical; H = Female surgical; I = Male medical; J = Female medical; K = Antenatal ward; L = Postnatal clinic; M = Postnatal ward; N = Surgical outpatient; O = Ear, Nose & Throat; P = Mental health; Q = Children orth. ward; R = Dermatology; S = Antenatal clinic; T = Radiology; U = Renal ward; V = Burns.

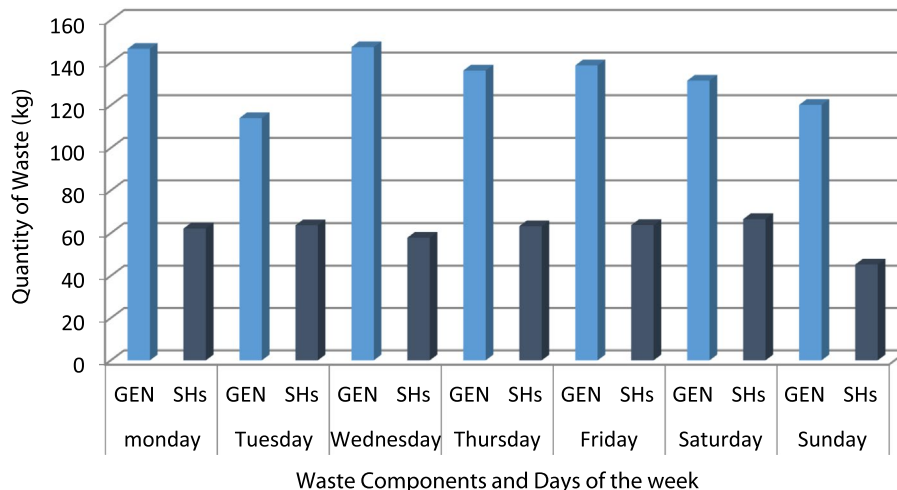
### 8. Quantity and composition of waste in OAUTHC in August

The summary of findings for the quantity of waste component generated in August, 2015 is shown in Figure 3. From Table 4, the total quantity of waste generated for the week is 1,387.4 kg (1.387 ton). Of this figure, the quantity of general waste was 964.6 kg (69.5%), while sharps on the other hand weighed 422.8 kg (30.5%).



**Figure 3. Quantity and composition of waste generated in OAUTHC in August.**

Notes: GEN = General waste and SHs = Sharps.



The quantity of waste generated in OAUTHC in the month of August was more than the other months (June and July). Therefore, 30.7% increment was recorded in August. Despite the increment, the trend in June and July was also observed in the month of August. As the days of the week increased (Mondays to Sundays) the volume of waste was at decrease except for Fridays where the quantity of waste slightly increased. This could be associated with the fact that Friday is usually the last active working day of the week.

Table 4 shows the quantity and composition of waste generated by individual wards in OAUTHC for the month of August. From the table, general waste constituted 964.6 kg (69.5%) while sharps accounted for 422.8 kg (30.5%). Findings as presented in the table revealed that the least quantity of waste was generated on Saturdays and Sundays. This is because of the low turn-out of the people for medical treatment on weekends. The hospital also doesn't operate actively on weekends, except for emergency cases.

### 9. Summary of quantity and composition of waste generated in OAUTHC in June, July and August 2015

Presented in Table 5 is the total quantity of waste generated in OAUTHC in the month of June, July and August 2015. Total waste generated within the survey period was 3,577 kg. The general waste accounted for 2,601.2 kg (2.6 tons) and it represented 72.7% of the total waste generated. Sharps was 975.8 kg (0.98 ton) representing 27.3% of the waste generated. There was a reduction of 14% in the waste production between June and July while there was an increase of 30.7% when the waste generated in July was compared to that of August.

Consequently, waste generated in the month of August accounted for 39% of the total waste generated in three months of the survey. The month of June generation accounted for 33% of the three months while the percentage for the month of July represented 28%. The study further established that the general waste in June was 24% while Sharps represented 9%. Similarly in July, the general and Sharps waste accounted for 22 and 6%, respectively. While in August, general waste represented 27% while Sharps was 12%.

**Table 4. Quantity and composition of waste generated in OAUTHC in August**

Ward	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Grand total		
	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	Total
A	12.8	4.5	4.4	4.6	8.7	2.4	5.4	2.6	6.6	2.9	3.5	3.0	3.7	2.0	45.1	22.0	67.1
B	5.1	4.3	4.8	4.4	3.7	2.5	4.0	2.7	4.4	2.9	3.1	2.9	2.8	1.9	27.9	21.6	49.5
C	4.4	3.1	5.3	3.3	3.1	2.2	3.1	2.3	3.2	2.5	3.1	2.5	2.7	1.7	24.9	17.6	42.5
D	27.9	4.3	27.7	4.9	16.4	3.2	13.8	3.7	13.8	4.0	15.7	4.3	16.7	2.7	132.0	27.1	159.1
E	4.3	3.9	8.3	4.0	6.6	4.2	6.4	4.3	7.1	4.9	6.1	5.1	8.8	3.1	47.6	29.5	77.1
F	2.1	2.5	2.0	2.7	2.0	2.8	2.4	2.9	2.9	3.2	1.8	3.3	2.1	2.0	15.3	19.4	34.7
G	4.9	3.6	4.6	3.7	5.8	3.8	6.3	4.0	5.2	2.3	4.8	2.4	4.4	1.7	36.0	21.5	57.5
H	3.7	2.4	3.3	2.5	4.2	2.6	3.9	2.9	3.5	2.3	4.4	2.3	2.8	1.6	25.8	16.6	42.4
I	9.5	2.3	8.3	2.5	17	2.7	9.9	2.9	10.1	3.0	9.0	3.1	15.7	2.0	79.5	18.5	98.0
J	4.3	4.4	4.3	4.7	3.6	4.9	3.1	5.3	6.1	3.6	3.2	1.8	4.6	1.6	29.2	26.3	55.5
K	13.9	3.6	12.3	3.7	11.3	3.8	15	4.1	12.0	4.2	15.6	4.8	11.4	3.0	91.5	27.2	118.7
L	2.9	2.1	1.9	2.3	3.3	2.4	2.4	2.5	3.6	2.7	3.8	2.9	2.8	1.9	20.7	16.8	37.5
M	14.1	1.9	20.8	1.9	19	2.2	20.1	2.7	13.5	3.2	17.5	3.8	13.8	2.6	118.8	18.3	137.1
N	2.4	4.5	2.3	2.9	2.8	1.4	2.5	1.6	2.4	1.9	2.8	2.3	1.9	1.6	17.1	16.2	33.3
O	4.7	1.7	4.5	1.8	5.3	1.9	3.6	2.1	5.2	2.5	3.8	3.0	2.8	1.9	29.9	14.9	44.8
P	4.8	2.1	4.6	2.2	3.7	2.3	3.8	2.3	4.4	2.4	3.8	2.6	2.6	1.9	27.7	15.8	43.5
Q	2.2	2.3	3.5	2.3	2.2	2.4	3.0	2.5	4.1	2.7	5.1	2.8	2.8	2.5	22.9	17.5	40.4
R	2.7	1.1	1.9	1.1	3.7	1.3	3.6	2.3	2.8	2.4	2.7	2.5	2.5	1.7	19.9	12.4	32.3
S	1.9	1.3	1.9	1.5	2.0	1.6	2.4	1.7	2.3	1.7	1.8	1.9	1.9	1.6	14.2	11.3	25.5
T	7.7	2.9	5.6	2.9	7.5	3.2	6.5	3.4	7.4	3.5	6.1	3.7	2.8	2.3	43.6	21.9	65.5
U	2.3	1.3	2.8	1.6	5.1	1.7	6.6	1.9	5.3	2.1	6.3	2.5	4.6	1.9	33.0	13.0	46.0
V	7.9	2.1	8.9	2.2	10.3	2.4	8.5	2.6	12.8	2.9	7.6	3.1	6.0	2.1	62.0	17.4	79.4
Total	146.5	62.2	144	63.7	147.3	57.9	136.3	63.3	138.7	63.8	131.6	66.6	120.2	45.3	964.6	422.8	1,387.4
Total waste generated (kg)	208.7		207.7		205.2		199.6		202.5		198.2		165.5		1,387.4		
Percentage	15.04		14.97		14.79		14.38		14.60		14.29		11.93		100		
Number of generators	202		186		180		185		189		191		198		1,331		
Per capita (kg)	1.033		1.117		1.140		1.079		1.071		1.030		0.836		1.042		

Notes: A = Children ward; B = Pediatric surgery; C = Children emergency; D = Adult emergency; E = Adult orthopedic; F = Gynecological ward; G = Male surgical; H = Female surgical; I = Male medical; J = Female medical; K = Antenatal ward; L = Postnatal clinic; M = Postnatal ward; N = Surgical outpatient; O = Ear, Nose & Throat; P = Mental health; Q = Children orth. ward; R = Dermatology; S = Antenatal clinic; T = Radiology; U = Renal ward; V = Burns.

Having known the quantity and composition of waste generated in the three months, the data can be used to compute the daily and weekly per capita quantities. To do this, information on the daily generators was also needed. The numbers of generators for each of the week were as shown in Table 6.

### 10. Per capita solid waste generated in OAUTHC

The per capita quantity was established for each of the waste components generated in OAUTHC. This was arrived at using the number of patients in each of the wards (generators) as the divisor of the quantity of waste produced. The number of generators for the wards as presented in Table 6

**Table 5. Summary of quantity and composition of waste generated in OAUTHC in the month of June, July and August 2015**

Ward	June			July			August			Grand total		
	GEN	SHPs	Total	GEN	SHPs	Total	GEN	SHPs	Total	GEN	SHPs	Total
A	40.2	17.1	57.3	36.7	13.6	50.3	45.1	22.0	67.1	122.0	52.7	174.7
B	23.0	16.7	39.7	19.5	13.2	32.7	27.9	21.6	49.5	70.4	51.5	121.9
C	20.0	12.7	32.7	16.5	9.2	25.7	24.9	17.6	42.5	61.4	39.5	100.9
D	127.1	22.2	149.3	123.6	18.7	142.3	132	27.1	159.1	382.7	68.0	450.7
E	42.7	24.6	67.3	39.2	21.1	60.3	47.6	29.5	77.1	129.5	75.2	204.7
F	10.4	14.5	24.9	6.9	11.0	17.9	15.3	19.4	34.7	32.6	44.9	77.5
G	31.1	16.6	47.7	27.6	13.1	40.7	36.0	21.5	57.5	94.7	51.2	145.9
H	20.9	11.7	32.6	17.4	8.2	25.6	25.8	16.6	42.4	64.1	36.5	100.6
I	74.6	13.6	88.2	71.1	10.1	81.2	79.5	18.5	98.0	225.2	42.2	267.4
J	24.3	21.4	45.7	20.8	17.9	38.7	29.2	26.3	55.5	74.3	65.6	139.9
K	86.6	22.3	108.9	83.1	18.8	101.9	91.5	27.2	118.7	261.2	68.3	329.5
L	15.8	11.9	27.7	12.3	8.4	20.7	20.7	16.8	37.5	48.8	37.1	85.9
M	113.9	13.4	127.3	110.4	9.9	120.3	118.8	18.3	137.1	343.1	41.6	384.7
N	12.2	11.3	23.5	8.7	7.8	16.5	17.1	16.2	33.3	38.0	35.3	73.3
O	25.0	10.0	35.0	21.5	6.5	28.0	29.9	14.9	44.8	76.4	31.4	107.8
P	22.8	10.9	33.7	19.3	7.4	26.7	27.7	15.8	43.5	69.8	34.1	103.9
Q	18.0	12.6	30.6	14.5	9.1	23.6	22.9	17.5	40.4	55.4	39.2	94.6
R	15.0	7.5	22.5	11.5	4.0	15.5	19.9	12.4	32.3	46.4	23.9	70.3
S	9.3	6.4	15.7	5.8	2.9	8.7	14.2	11.3	25.5	29.3	20.6	49.9
T	38.7	17.0	55.7	35.2	13.5	48.7	43.6	21.9	65.5	117.5	52.4	169.9
U	28.1	8.1	36.2	24.6	4.6	29.2	33.0	13.0	46.0	85.7	25.7	111.4
V	57.1	12.5	69.6	53.6	9.0	62.6	62.0	17.4	79.4	172.7	38.9	211.6
Total	856.8	315	1,171.8	779.8	238	1,017.8	964.6	422.8	1,387.4	2,601.2	975.8	3,577

Notes: A = Children ward; B = Pediatric surgery; C = Children emergency; D = Adult emergency; E = Adult orthopedic; F = Gynecological ward; G = Male surgical; H = Female surgical; I = Male medical; J = Female medical; K = Antenatal ward; L = Postnatal clinic; M = Postnatal ward; N = Surgical outpatient; O = Ear, Nose & Throat; P = Mental health; Q = Children orth. ward; R = Dermatology; S = Antenatal clinic; T = Radiology; U = Renal ward; V = Burns.

**Table 6. Estimated waste generators in OAUTHC during the survey**

Days	Months			Total
	June	July	August	
Monday	232	228	202	662
Tuesday	227	229	186	642
Wednesday	237	227	180	644
Thursday	227	223	185	635
Friday	230	208	189	627
Saturday	220	208	191	619
Sunday	228	216	198	642
Total	1,601	1,539	1,331	4,471

**Table 7. Waste generated per month in OAUTHC during the survey**

Days	Months			Total	%
	June	July	August		
Monday	177.9	155.9	208.7	542.5	15.17
Tuesday	176.9	154.9	207.7	539.5	15.08
Wednesday	174.4	152.4	205.2	532.0	14.87
Thursday	168.8	146.8	199.6	515.2	14.40
Friday	171.1	149.7	202.5	523.3	14.63
Saturday	167.4	145.5	198.2	511.1	14.29
Sunday	134.7	112.7	165.5	412.9	11.54
Total	1,171.2	1,017.9	1,387.4	3,576.5	100

established variation across the days of the week. In the month of June, the generators were 232, 227, 237, 227, 230, 220, and 228 on Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, and Sunday, respectively. In the month of July, the generators were 228, 229, 227, 223, 208, 208, and 216 on Monday through Sunday, respectively. Lastly the generators for the month of August were 202, 186, 180, 185, 189, 191 and 198 on Monday, Tuesday, Wednesday, Thursday, Friday, Saturday and Sunday, respectively. The quantity of waste generated in the period was 3,577 kg (3.6 tons).

Findings on the solid waste generated per month in OAUTHC as summarized in Table 7 revealed that Mondays and Tuesdays accounted for the highest quantity of waste generated. The quantities of waste generated on Mondays were 177.9, 155.9, and 208.7 kg, for the month of June, July and August, respectively. The amounts of waste produced on Tuesdays in the same period were 176.9, 154.9, and 207.7 kg, respectively. This could be as a result of clinic and appointments days for patients to consult the doctors, for proper management and maintenance of their ailments. However, the least quantity of waste generated in OAUTHC was recorded on Sundays with 134.7, 112.7, and 165.5 kg, respectively for the three months under study. This could also be associated to the fact that in OAUTHC weekends are mainly for emergency situation and patients on chronic and pathetic situation.

### 11. Per capita solid waste generated in OAUTHC in June, July and August

The daily per capita solid waste generated for the month of June, July and August is presented in Table 8–10, respectively. In the month of June, Tuesday accounted for the highest per capita waste generated, which was 0.779 kg. The reason for this increase was the accumulation of solid waste generated on Mondays evening added with the Tuesday morning waste components. The least per capita was recorded on Sunday with 0.591 kg. This was because low patronage of people that mostly recorded on Sunday affected the quantity of waste generation.

Table 9 shows the per capita solid waste generated in OAUTHC for the month of July. The average per ward waste generated was arrived at, addition of the weekly per capita waste generated for the respective wards, divided by the numbers of wards. This includes 0.2105 kg. Summarized in Table 10 were the computed per capita solid waste generated in OAUTHC in August. Average per capita daily waste generated in the month of August was 1.044 kg. This was arrived at, by the addition of the daily per capita waste generated across the wards, divided by number of days.

### 12. Summary of per capita solid waste generated in OAUTHC in June, July and August

The per capita quantity indicated for each month was for a week. From the weekly figure for the respective months, the average daily per capita quantity was arrived at by dividing the figure by the number of days in a week. Thus, the daily per capita quantity in June was  $(5.124 \text{ kg} \div 7) = 0.732 \text{ kg}$  while the daily per capita quantity in July was  $(4.630 \text{ kg} \div 7) = 0.661 \text{ kg}$  and the daily per capita

**Table 8. Weekly and daily per capita generation by specific component in OAUTHC in June 2015**

Ward	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Weekly per capita			Daily per capita		
	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	Total	GEN	SHs	Total
A	0.052	0.016	0.016	0.017	0.034	0.007	0.021	0.008	0.026	0.010	0.013	0.010	0.013	0.006	0.0174	0.075	0.249	0.025	0.011	0.036
B	0.019	0.016	0.018	0.016	0.013	0.008	0.015	0.009	0.016	0.010	0.011	0.010	0.009	0.005	0.100	0.073	0.173	0.014	0.010	0.025
C	0.016	0.010	0.020	0.011	0.010	0.006	0.011	0.007	0.011	0.008	0.011	0.008	0.009	0.004	0.087	0.056	0.143	0.012	0.008	0.020
D	0.117	0.016	0.119	0.019	0.066	0.011	0.058	0.013	0.057	0.014	0.068	0.016	0.070	0.009	0.555	0.097	0.653	0.079	0.014	0.093
E	0.016	0.014	0.033	0.015	0.025	0.015	0.025	0.016	0.028	0.018	0.025	0.020	0.036	0.011	0.187	0.108	0.295	0.027	0.015	0.042
F	0.006	0.008	0.006	0.009	0.005	0.009	0.007	0.010	0.010	0.011	0.005	0.012	0.006	0.006	0.045	0.064	0.109	0.006	0.009	0.016
G	0.018	0.013	0.017	0.013	0.022	0.013	0.025	0.015	0.020	0.007	0.019	0.008	0.016	0.004	0.136	0.072	0.208	0.019	0.010	0.030
H	0.013	0.007	0.011	0.008	0.015	0.008	0.014	0.010	0.012	0.007	0.017	0.007	0.009	0.004	0.091	0.051	0.143	0.013	0.007	0.020
I	0.038	0.007	0.033	0.008	0.069	0.008	0.041	0.010	0.041	0.010	0.038	0.011	0.066	0.006	0.325	0.060	0.385	0.046	0.009	0.055
J	0.016	0.016	0.016	0.018	0.012	0.018	0.011	0.020	0.023	0.013	0.011	0.005	0.017	0.004	0.106	0.093	0.199	0.015	0.013	0.028
K	0.057	0.013	0.051	0.013	0.045	0.013	0.063	0.015	0.049	0.015	0.068	0.019	0.047	0.010	0.380	0.098	0.477	0.054	0.014	0.068
L	0.009	0.006	0.005	0.007	0.011	0.007	0.007	0.008	0.013	0.009	0.014	0.010	0.009	0.005	0.069	0.052	0.121	0.010	0.007	0.017
M	0.058	0.005	0.089	0.005	0.077	0.006	0.085	0.009	0.056	0.011	0.076	0.014	0.057	0.008	0.498	0.059	0.557	0.071	0.008	0.080
N	0.007	0.016	0.007	0.010	0.009	0.003	0.008	0.004	0.007	0.005	0.010	0.007	0.005	0.004	0.053	0.049	0.103	0.008	0.007	0.015
O	0.017	0.004	0.017	0.005	0.019	0.005	0.013	0.006	0.020	0.008	0.014	0.010	0.009	0.005	0.109	0.044	0.153	0.016	0.006	0.022
P	0.018	0.006	0.017	0.007	0.013	0.007	0.014	0.007	0.016	0.007	0.014	0.009	0.008	0.005	0.100	0.048	0.147	0.014	0.007	0.021
Q	0.006	0.007	0.012	0.007	0.006	0.007	0.010	0.008	0.015	0.009	0.020	0.010	0.009	0.008	0.079	0.055	0.134	0.011	0.008	0.019
R	0.009	0.002	0.005	0.002	0.013	0.003	0.013	0.007	0.009	0.007	0.009	0.008	0.008	0.004	0.065	0.033	0.098	0.009	0.005	0.014
S	0.005	0.003	0.005	0.004	0.005	0.004	0.007	0.004	0.007	0.004	0.005	0.005	0.005	0.004	0.041	0.028	0.069	0.006	0.004	0.010
T	0.030	0.009	0.022	0.010	0.029	0.011	0.026	0.012	0.029	0.012	0.025	0.014	0.009	0.007	0.169	0.074	0.243	0.024	0.011	0.035
U	0.007	0.003	0.009	0.004	0.019	0.004	0.026	0.005	0.020	0.006	0.025	0.008	0.017	0.005	0.123	0.036	0.159	0.018	0.005	0.023
V	0.031	0.006	0.036	0.007	0.041	0.007	0.034	0.008	0.053	0.010	0.031	0.011	0.023	0.006	0.249	0.055	0.304	0.036	0.008	0.043
Total	0.565	0.202	0.567	0.213	0.557	0.179	0.533	0.211	0.536	0.210	0.528	0.233	0.460	0.131	3.745	1.379	5.124	0.535	0.197	0.732
PCW	0.767		0.779		0.736		0.744		0.747		0.761		0.591		5.124					0.732

Notes: A = Children ward; B = Pediatric surgery; C = Children emergency; D = Adult emergency; E = Adult orthopedic; F = Gynecological ward; G = Male surgical; H = Female surgical; I = Male medical; J = Female medical; K = Antenatal ward; L = Postnatal ward; M = Postnatal clinic; N = Surgical outpatient; O = Ear, Nose & Throat; P = Mental health; Q = Children orth. ward; R = Dermatology; S = Antenatal clinic; T = Radiology; U = Renal ward; V = Burns.

**Table 9. Weekly and daily per capita generation by specific component in OAUTHC in July 2015**

Ward	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Weekly per capita			Daily per capita		
	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	Total	GEN	SHs	Total
A	0.051	0.014	0.014	0.015	0.033	0.005	0.019	0.006	0.026	0.008	0.011	0.009	0.012	0.004	0.165	0.061	0.227	0.024	0.009	0.032
B	0.017	0.014	0.016	0.014	0.011	0.006	0.013	0.007	0.015	0.008	0.009	0.008	0.007	0.003	0.088	0.060	0.148	0.013	0.009	0.021
C	0.014	0.008	0.018	0.009	0.008	0.004	0.009	0.005	0.010	0.006	0.009	0.006	0.007	0.002	0.075	0.042	0.116	0.011	0.006	0.017
D	0.117	0.014	0.116	0.016	0.067	0.009	0.057	0.011	0.061	0.013	0.070	0.015	0.072	0.007	0.558	0.085	0.643	0.080	0.012	0.092
E	0.014	0.012	0.031	0.012	0.024	0.013	0.023	0.014	0.028	0.018	0.024	0.019	0.035	0.009	0.179	0.097	0.275	0.026	0.014	0.039
F	0.004	0.006	0.003	0.007	0.004	0.007	0.005	0.008	0.008	0.010	0.003	0.010	0.004	0.004	0.032	0.050	0.082	0.005	0.007	0.012
G	0.016	0.011	0.015	0.011	0.020	0.011	0.023	0.013	0.019	0.005	0.017	0.006	0.015	0.002	0.126	0.059	0.184	0.018	0.008	0.026
H	0.011	0.005	0.009	0.006	0.013	0.006	0.012	0.008	0.011	0.005	0.015	0.005	0.007	0.002	0.079	0.037	0.116	0.011	0.005	0.017
I	0.036	0.005	0.031	0.006	0.070	0.007	0.039	0.008	0.043	0.009	0.038	0.009	0.067	0.004	0.323	0.046	0.370	0.046	0.007	0.053
J	0.014	0.014	0.014	0.015	0.011	0.016	0.009	0.018	0.024	0.012	0.010	0.003	0.016	0.002	0.095	0.080	0.175	0.014	0.011	0.025
K	0.056	0.011	0.048	0.011	0.044	0.011	0.062	0.013	0.052	0.014	0.069	0.017	0.047	0.008	0.379	0.086	0.465	0.054	0.012	0.066
L	0.007	0.004	0.003	0.005	0.009	0.005	0.005	0.006	0.012	0.007	0.013	0.008	0.007	0.003	0.057	0.038	0.095	0.008	0.005	0.014
M	0.057	0.003	0.086	0.003	0.078	0.004	0.085	0.007	0.059	0.010	0.078	0.013	0.058	0.006	0.501	0.046	0.547	0.072	0.007	0.078
N	0.005	0.014	0.005	0.007	0.007	0.001	0.006	0.002	0.006	0.003	0.008	0.005	0.003	0.002	0.040	0.035	0.075	0.006	0.005	0.011
O	0.015	0.002	0.014	0.003	0.018	0.003	0.011	0.004	0.019	0.006	0.013	0.009	0.007	0.003	0.098	0.030	0.128	0.014	0.004	0.018
P	0.016	0.004	0.015	0.004	0.011	0.005	0.012	0.005	0.015	0.006	0.013	0.007	0.006	0.003	0.088	0.034	0.122	0.013	0.005	0.017
Q	0.004	0.005	0.010	0.005	0.004	0.005	0.008	0.006	0.014	0.007	0.019	0.008	0.007	0.006	0.067	0.042	0.109	0.010	0.006	0.016
R	0.007	0.000	0.003	0.000	0.011	0.000	0.011	0.005	0.008	0.006	0.007	0.006	0.006	0.002	0.052	0.019	0.071	0.007	0.003	0.010
S	0.003	0.000	0.003	0.001	0.004	0.002	0.005	0.002	0.005	0.002	0.003	0.003	0.003	0.002	0.026	0.013	0.040	0.004	0.002	0.006
T	0.029	0.007	0.019	0.007	0.028	0.009	0.024	0.010	0.030	0.011	0.024	0.012	0.007	0.005	0.160	0.062	0.222	0.023	0.009	0.032
U	0.005	0.000	0.007	0.002	0.017	0.002	0.024	0.003	0.020	0.004	0.025	0.006	0.016	0.003	0.113	0.021	0.135	0.016	0.003	0.019
V	0.029	0.004	0.034	0.004	0.040	0.005	0.033	0.006	0.056	0.008	0.031	0.009	0.022	0.004	0.245	0.041	0.286	0.035	0.006	0.041
Total	0.527	0.157	0.514	0.163	0.533	0.139	0.493	0.165	0.540	0.180	0.506	0.193	0.434	0.088	3.546	1.085	4.630	0.507	0.155	0.661
PCW	0.684		0.676		0.671		0.658		0.720		0.699		0.522		4.630					0.661

Notes: A = Children ward; B = Pediatric surgery; C = Children emergency; D = Adult emergency; E = Adult orthopedic; F = Gynecological ward; G = Male surgical; H = Female surgical; I = Male medical; J = Female medical; K = Antenatal ward; L = Postnatal ward; M = Postnatal clinic; N = Surgical outpatient; O = Ear, Nose & Throat; P = Mental health; Q = Children orth. ward; R = Dermatology; S = Antenatal clinic; T = Radiology; U = Renal ward; V = Burns.

**Table 10. Weekly and daily per capita generation by specific component in OAUTHC in August 2015**

Ward	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday		Weekly per capita			Daily per capita		
	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	GEN	SHs	Total	GEN	SHs	Total
A	0.063	0.022	0.024	0.025	0.048	0.013	0.029	0.014	0.035	0.015	0.018	0.016	0.019	0.010	0.236	0.116	0.352	0.034	0.017	0.050
B	0.025	0.021	0.026	0.024	0.021	0.014	0.022	0.015	0.023	0.015	0.016	0.015	0.014	0.010	0.147	0.114	0.260	0.021	0.016	0.037
C	0.022	0.015	0.028	0.018	0.017	0.012	0.017	0.012	0.017	0.013	0.016	0.013	0.014	0.009	0.131	0.093	0.224	0.019	0.013	0.032
D	0.138	0.021	0.149	0.026	0.091	0.018	0.075	0.020	0.073	0.021	0.082	0.023	0.084	0.014	0.692	0.143	0.835	0.099	0.020	0.119
E	0.021	0.019	0.045	0.022	0.037	0.023	0.035	0.023	0.038	0.026	0.032	0.027	0.044	0.016	0.251	0.156	0.407	0.036	0.022	0.058
F	0.010	0.012	0.011	0.015	0.011	0.016	0.013	0.016	0.015	0.017	0.009	0.017	0.011	0.010	0.081	0.102	0.183	0.012	0.015	0.026
G	0.024	0.018	0.025	0.020	0.032	0.021	0.034	0.022	0.028	0.012	0.025	0.013	0.022	0.009	0.190	0.114	0.304	0.027	0.016	0.043
H	0.018	0.012	0.018	0.013	0.023	0.014	0.021	0.016	0.019	0.012	0.023	0.012	0.014	0.008	0.136	0.088	0.224	0.019	0.013	0.032
I	0.047	0.011	0.045	0.013	0.094	0.015	0.054	0.016	0.053	0.016	0.047	0.016	0.079	0.010	0.419	0.098	0.517	0.060	0.014	0.074
J	0.021	0.022	0.023	0.025	0.020	0.027	0.017	0.029	0.032	0.019	0.017	0.009	0.023	0.008	0.153	0.139	0.293	0.022	0.020	0.042
K	0.069	0.018	0.066	0.020	0.063	0.021	0.081	0.022	0.063	0.022	0.082	0.025	0.058	0.015	0.482	0.143	0.625	0.069	0.020	0.089
L	0.014	0.010	0.010	0.012	0.018	0.013	0.013	0.014	0.019	0.014	0.020	0.015	0.014	0.010	0.109	0.089	0.198	0.016	0.013	0.028
M	0.070	0.009	0.112	0.010	0.106	0.012	0.109	0.015	0.071	0.017	0.092	0.020	0.070	0.013	0.629	0.096	0.725	0.090	0.014	0.104
N	0.012	0.022	0.012	0.016	0.016	0.008	0.014	0.009	0.013	0.010	0.015	0.012	0.010	0.008	0.090	0.084	0.175	0.013	0.012	0.025
O	0.023	0.008	0.024	0.010	0.029	0.011	0.019	0.011	0.028	0.013	0.020	0.016	0.014	0.010	0.158	0.079	0.236	0.023	0.011	0.034
P	0.024	0.010	0.025	0.012	0.021	0.013	0.021	0.012	0.023	0.013	0.020	0.014	0.013	0.010	0.146	0.083	0.229	0.021	0.012	0.033
Q	0.011	0.011	0.019	0.012	0.012	0.013	0.016	0.014	0.022	0.014	0.027	0.015	0.014	0.013	0.121	0.092	0.213	0.017	0.013	0.030
R	0.013	0.005	0.010	0.006	0.021	0.007	0.019	0.012	0.015	0.013	0.014	0.013	0.013	0.009	0.105	0.065	0.171	0.015	0.009	0.024
S	0.009	0.006	0.010	0.008	0.011	0.009	0.013	0.009	0.012	0.009	0.009	0.010	0.010	0.008	0.075	0.060	0.134	0.011	0.009	0.019
T	0.038	0.014	0.030	0.016	0.042	0.018	0.035	0.018	0.039	0.019	0.032	0.019	0.014	0.012	0.230	0.116	0.346	0.033	0.017	0.049
U	0.011	0.006	0.015	0.009	0.028	0.009	0.036	0.010	0.028	0.011	0.033	0.013	0.023	0.010	0.175	0.069	0.243	0.025	0.010	0.035
V	0.039	0.010	0.048	0.012	0.057	0.013	0.046	0.014	0.068	0.015	0.040	0.016	0.030	0.011	0.328	0.092	0.420	0.047	0.013	0.060
Total	0.725	0.308	0.774	0.342	0.818	0.322	0.737	0.342	0.734	0.338	0.689	0.349	0.607	0.229	5.084	2.229	7.314	0.726	0.318	1.045
PCW	1.033		1.117		1.140		1.079		1.071		1.038		0.836		7.314					1.045

Notes: A = Children ward; B = Pediatric surgery; C = Children emergency; D = Adult emergency; E = Adult orthopedic; F = Gynecological ward; G = Male surgical; H = Female surgical; I = Male medical; J = Female medical; K = Antenatal ward; L = Postnatal ward; M = Postnatal clinic; N = Surgical outpatient; O = Ear, Nose & Throat; P = Mental health; Q = Children orth. ward; R = Dermatology; S = Antenatal clinic; T = Radiology; U = Renal ward; V = Burns.



**Table 11. Monthly per capita generation by specific component in OAUTHC in June, July and August 2015**

Ward	June			July			August			Grand total		
	GEN	SHPs	Total	GEN	SHPs	Total	GEN	SHPs	Total	GEN	SHPs	Total
A	0.174	0.075	0.249	0.165	0.061	0.227	0.236	0.116	0.352	0.575	0.252	0.827
B	0.100	0.073	0.173	0.088	0.06	0.148	0.147	0.114	0.260	0.335	0.247	0.582
C	0.087	0.056	0.143	0.075	0.042	0.116	0.131	0.093	0.224	0.293	0.191	0.484
D	0.555	0.097	0.653	0.558	0.085	0.643	0.692	0.143	0.835	1.805	0.325	2.13
E	0.187	0.108	0.295	0.179	0.097	0.275	0.251	0.156	0.407	0.617	0.361	0.978
F	0.045	0.064	0.109	0.032	0.05	0.082	0.081	0.102	0.183	0.158	0.216	0.374
G	0.136	0.072	0.208	0.126	0.059	0.184	0.190	0.114	0.304	0.452	0.245	0.697
H	0.091	0.051	0.143	0.079	0.037	0.116	0.136	0.088	0.224	0.306	0.176	0.482
I	0.325	0.060	0.385	0.323	0.046	0.370	0.419	0.098	0.517	1.067	0.204	1.271
J	0.106	0.093	0.199	0.095	0.080	0.175	0.153	0.139	0.293	0.354	0.312	0.666
K	0.380	0.098	0.477	0.379	0.086	0.465	0.482	0.143	0.625	1.241	0.327	1.568
L	0.069	0.052	0.121	0.057	0.038	0.095	0.109	0.089	0.198	0.235	0.179	0.414
M	0.498	0.059	0.557	0.501	0.046	0.547	0.629	0.096	0.725	1.628	0.201	1.829
N	0.053	0.049	0.103	0.040	0.035	0.075	0.090	0.084	0.175	0.183	0.168	0.351
O	0.109	0.044	0.153	0.098	0.030	0.128	0.158	0.079	0.236	0.365	0.153	0.518
P	0.100	0.048	0.147	0.088	0.034	0.122	0.146	0.083	0.229	0.334	0.165	0.499
Q	0.079	0.055	0.134	0.067	0.042	0.109	0.121	0.092	0.213	0.267	0.189	0.456
R	0.065	0.033	0.098	0.052	0.019	0.071	0.105	0.065	0.171	0.222	0.117	0.339
S	0.041	0.028	0.069	0.026	0.013	0.040	0.075	0.060	0.134	0.142	0.101	0.243
T	0.169	0.074	0.243	0.160	0.062	0.222	0.230	0.116	0.346	0.559	0.252	0.811
U	0.123	0.036	0.159	0.113	0.021	0.135	0.175	0.069	0.243	0.411	0.126	0.537
V	0.249	0.055	0.304	0.245	0.041	0.286	0.328	0.092	0.420	0.822	0.188	1.01
Total	3.745	1.379	5.124	3.546	1.085	4.63	5.084	2.229	7.314	12.375	4.693	17.068

Notes: A = Children ward; B = Pediatric surgery; C = Children emergency; D = Adult emergency; E = Adult orthopedic; F = Gynecological ward; G = Male surgical; H = Female surgical; I = Male medical; J = Female medical; K = Antenatal ward; L = Postnatal clinic; M = Postnatal ward; N = Surgical outpatient; O = Ear, Nose & Throat; P = Mental health; Q = Children orth. ward; R = Dermatology; S = Antenatal clinic; T = Radiology; U = Renal ward; V = Burns.

quantity in August was  $(7.314 \text{ kg} \div 7) = 1.045 \text{ kg}$ . The highest daily per capita quantity was recorded in the month of August (see Table 11).

However, The daily per capita waste generated for the all the wards for the whole period of survey except virology department of OAUTHC was  $(3576.5 \div 4471) = 0.799 \text{ kg}$ .

### 13. Conclusion and recommendations

This study assessed the solid waste composition of Obafemi Awolowo University Teaching Hospital Complex (OAUTHC) Ile-Ife, Nigeria. It determined the quantity and components of solid waste generated in OAUTHC Ile-Ife. Findings established that solid wastes generated in majority of the wards of OAUTHC were sorted into two components (General waste and sharps). Waste components generated in the virology department were sorted into four components, which were: highly infectious, infectious, general waste, and sharps. It was established that sharps and general waste generated in wards represented 27.3 and 72.7%, respectively. However, from the results of the study, it was obvious that health care waste management in OAUTHC was not practiced according to World Health Organization (WHO) recommended standards.

Before the recommendation, during the period of the study, there were number of problems faced by the hospital in managing its solid waste generated. The problems include: *Failure to quantify the solid waste generated in reliable records, intermingling of hazardous waste with domestic waste, Lack of use of coloured bags or plastic container, among others.*

The following recommendations are made with the hope of enhancing the operating efficiency of the hospital with regards to health care waste management:

- (1) *Actual measurement of solid waste generated:* There is need to intermittently determine the quantity of health care waste generated in the study area. The provision of weighing scales will help to determine the quantity of health care waste generated in every ward or location before collection. With this, it is possible to determine precisely the quantity of waste generated per head in the health facility. It will also help to ascertain which unit or department generates the highest or lowest waste quantity. This could have implications on resource allocation in managing health care solid waste. It can also be used to draw waste management plan or guide for the study area.
- (2) *Segregation of the waste generated at the source:* There is need for proper segregation of health care waste from the source. Segregation of solid waste generated in hospital is a feasible way to significantly reduce the quantity of infectious waste which is more expensive to manage. Any contact between the infectious waste with others means that the total waste (infectious, general and domestic waste) has to be considered as infectious waste. This will require more attention for handling. Every hospital should therefore, be compelled to adhere to the internationally recommended standards for hospital waste management.
- (3) *Use of symbol and colour code:* Bags and containers for infectious waste should be marked with Biohazard symbol. There is need to use proper containers for the segregation with specific color codes in all wards. This will prevent mixing of the different waste types or components. Imposition of segregation practices within the hospital will result in a clean waste stream which can be easily, safely and cost-effectively managed.
- (4) *Provision of standard storage facilities:* Adequate standard storage facilities should be provided to all the necessary areas in the hospital. The entire worn-out or obsolete waste receptacle should be replaced. The storage receptacles should be properly cleaned and disinfected regularly. This will aid in preventing possibility of any spread of diseases. Leakage from the waste receptacle should be prevented. These should be properly secured to prevent any unauthorized person from gaining access to it.

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